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Association between socioeconomic and nutritional factors and height of Brazilian adolescents: results from the *Study of Cardiovascular Risk in Adolescents*

Associação entre fatores socioeconômicos e nutricionais e altura de adolescentes brasileiros: resultados do *Estudo de Riscos Cardiovasculares em Adolescentes*

Asociación entre los factores socioeconómicos y nutricionales y la estatura de los adolescentes brasileños: resultados del *Estudio de Riesgo Cardiovascular en Adolescentes*

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Abstract

This study aims to describe the mean height of adolescents from the five regions of Brazil and to evaluate socioeconomic and nutritional factors associated with normal growth. This is a cross-sectional study conducted in the Brazilian urban and rural areas with students aged 12 to 17 years (n = 71,553). Anthropometry, socioeconomic variables, physical activity, and diet were evaluated. Height-for-age z-scores were calculated and multiple linear regression models were used to investigate the association of exposure variables with height (outcome) by sex and age (12-13, 14-15, and 16-17 years). We observed a lower mean height in adolescents from the North Region and in individuals with low socioeconomic status. At 17 years of age, the closest to the final height in this sample, mean heights for girls and boys were 160.9 ± 0.1cm and 173.7 ± 0.3cm, respectively. In multiple linear regression analysis, physical activity (girls β = 0.119, 95%CI: 0.035; 0.202; boys β = 0.092, 95%CI: 0.012; 0.172) and high level of maternal education (girls β = 0.103, 95%CI: 0.001; 0.204; boys β = 0.39, 95%CI: 0.245; 0.534) were positively associated with height-for-age z-score in 16- to 17-year-old boys and girls. Other factors positively associated with height-for-age z-score in older students include higher protein consumption (β = 0.022, 95%CI: 0.010; 0.035) and obesity (β = 0.217, 95%CI: 0.084; 0.350) for boys, and low weight (β = 0.205, 95%CI: 0.028, 0.382) for girls. We observed differences in the mean height among adolescents from the five Brazilian regions. Normal growth, especially among older adolescents, was associated with high maternal education, practice of physical activity, protein consumption, and body mass index (BMI) categories.

Body Height; Anthropometry; Adolescent; Socioeconomic Factors

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Introduction

Growth measurement is an important nutritional status marker for children and adolescents and is also associated with health outcomes [1,2]. Catch-up growth in height can occur in late childhood and early adolescence, but it rarely happens if adverse nutritional environment persists into adolescence [3]. Short stature for age is associated with greater morbidity and mortality in adulthood [4].

Adolescence is the transitional phase of growth and development between childhood and adulthood, and it represents the physical, hormonal, and psychological transformation occurring from 10 to 19 years of age [5]. In this phase, growth velocity increases, characterized by the pubertal growth spurt and a gain of approximately 15% of the final adult height [6]. Moreover, it is a critical period for acquiring adult stature and is associated with increased nutritional requirements to maintain the rapid tissue expansion and physical and sexual maturation [7,8]. Therefore, nutrition in childhood and early adolescence affects the timing and duration of puberty, linear growth, body composition, and maturation of other physiological systems [3].

Although many studies have assessed growth from conception to five years of age, little data exists for older children and adolescents [9,10,11]. The pubertal transition offers a nutrition-sensitive window to promote healthy growth. Several factors, other than genetics, are determinant in an individual's final height. Birth weight and length, nutritional status and behaviors, social class at birth, neighborhood income, maternal age, and chronic diseases have been shown to affect adult height [12,13,14]. In this context, data on the influence of childhood social and nutritional disparities on growth and near-adult height in Brazil are scarce. Additionally, to our knowledge, no study has reported mean height of school-aged adolescents from the five regions of Brazil. Therefore, this anthropometric survey is relevant for future policies to increase access to sanitation, health services, and better living conditions among adolescents in the community.

The *Study of Cardiovascular Risk in Adolescents* (ERICA) was designed to describe population patterns of anthropometric parameters and assess the prevalence of cardiovascular risk factors among Brazilian adolescents aged 12 to 17 years nationwide. This study aims to describe the mean height of adolescents who are representative of the five Brazilian regions, as well as to evaluate socioeconomic and nutritional factors associated with normal growth.

Methods

Design and sample

ERICA is a national multicenter, school-based, cross-sectional study conducted in urban and rural areas throughout Brazil. The sample consists of students aged from 12 to 17 years enrolled in private and public schools in Brazilian municipalities with at least 100,000 inhabitants. This study was approved by the research ethics committees of all 27 Federative Units. All adolescents and their legal guardians provided written informed assent/consent to participate in the study.

A complex sampling approach was used. The population frame that was sampled was stratified into the following 32 geographic strata: the 27 Federative Units capitals municipalities, and five strata comprising the other municipalities with more than 100,000 inhabitants within each region of the country. The schools were selected based on probability proportional to size (number of students per school) and inversely proportional to the distance between the school's municipality and the Federative Unit capital. Overall, 1,247 schools in 124 municipalities were selected. In each school, three classrooms were randomly selected, and all students in those classes were invited to participate in ERICA. Data were collected from February 2013 to November 2014. Further details regarding the sampling and design of the ERICA have been described in a previous study [15]. The participation rate for adolescents who completed the ERICA questionnaires, dietary recall, and anthropometric measures was 70.1% [16].

Anthropometric measures

Anthropometric measurements were performed with the individuals wearing light clothing and no shoes. Height was measured to the nearest millimeter with a 213cm calibrated portable stadiometer (Alturexata, Belo Horizonte, Brazil). The subjects were in full standing position, following the Frankfort horizontal plane. Two measurements were made consecutively for quality control purposes. A maximum variation of 0.5cm was accepted between the measurements; if the difference exceeded 0.5cm, the measurements were deleted, and height was measured again in duplicate. The collected data were input into a personal digital assistant (LG model GM750Q; Cajamar, Brazil), which automatically calculated the mean of the two measures [17].

Body weight was measured using a digital scale (model P150m; Líder, Araçatuba, Brazil) with 50g precision. Body mass index [(BMI = weight (kg)/height (m^2)] was also calculated. The World Health Organization (WHO) reference curves were used to classify the adolescents' nutritional status [2]. The anthropometric measures were performed following standard practices [18].

Exposure variables and covariates

Exposure variables and covariates were investigated via a self-administered questionnaire using a personal digital assistant and 24-hour dietary recall. The following variables were examined as covariates: region (North, Northeast, Central-West, Southeast, and South); school area (urban, rural); sex (boy, girl); age, which was calculated from the day of birth until the day of data collection, and reported thereafter in years (ranging from 12-17 years-old); and ethnicity (white, black, mixed-race, or other – e.g., Asian or Indigenous). Tanner stages were used to classify pubertal development using information from the adolescents' self-assessment [19,20]. Each adolescent was categorized according to information about breast development for girls, genital development for boys, and pubic hair development for both sexes, with the highest value considered for classification. Information on age at menarche was also assessed by self-report.

The exposure variables included an adaptation of the economic index, used in the Brazilian census, to assess socioeconomic status based on the possession of certain goods (automobiles, refrigerators, and nine other item types), as well as having a family housekeeper [21]. Thereafter, the students were categorized into terciles based on the socioeconomic index. Maternal education was evaluated as years of education (0-3, 4-8, 9-12, and > 12). School type (public, private) was also assessed – regardless of the economic index – to determine socioeconomic status.

Physical activity was evaluated using the *Self-Administered Physical Activity Checklist* [22], which consists of a list of 24 activities (leisure-time and commuting) and allows the adolescent to report the frequency (days) and duration (hours and minutes) of participation in the last seven days. Adolescents who reported at least 60 min/day of physical activity were classified as active [23].

To assess dietary intake, a 24-hour dietary recall was performed during in-person interviews administered by trained researchers. To correct intra-individual variability, a second 24-hour dietary recall was collected on a non-consecutive day in a random subsample of approximately 10% of the total sample. The recall responses were entered directly into a netbook using the software created specifically for ERICA (ERICA-REC24h), which registered food consumption data [24]. The *Diet Quality Index for Brazilian Adolescents* (DQIA-BR) was calculated following technical aspects reported in a previous study [25]. Total scores vary from -33% to 100% and comprise the three main components of a healthy diet: quality, diversity, and equilibrium. Higher scores indicate higher diet quality.

Statistical analysis

The variables were described using means or proportions with their respective 95% confidence intervals (95%CI). Descriptive analysis of the outcome is presented stratified by age since growth velocity can vary over chronological ages, especially when disregarding the physical development stage. In the multivariable analysis, which was adjusted for the pubertal stage, ages were grouped every two years (12-13, 14-15, and 16-17 years of age) to facilitate the interpretation of the results, without significant loss of information. Height was reported in centimeters and as age- and sex-specific z-scores, calculated using WHO macros [2]. Growth from 12-17 years of age was estimated by the difference in height. The growth outcomes were described by region, socioeconomic status, school type, and BMI categories.

Multiple linear regression models were used to investigate the association between exposure variables and height-for-age z-score by sex and age. Two levels for exposure variables were considered. The first level included region, ethnicity, socioeconomic status, and pubertal development. These variables were entered in the model simultaneously and kept when p-value ≤ 0.2. The second level included, separately, BMI, diet indicators, and physical activity, keeping the adjustment for the variable entered in the first level. To obtain population-representative findings, the sample weights and complex sample design were considered in all analyses [15]. All data analyses were conducted in Stata version 14.0 (https://www.stata.com). All tests were two-tailed, and p-values < 0.05 were considered statistically significant.

Results

Overall, 71,553 ERICA participants were included in the analysis. Table 1 shows the adolescents' age distribution, sociodemographic characteristics, physical activity, diet quality index score, and Tanner stages. Out of the total sample, 55% were girls, 83% attended public schools, of which 96% were situated in urban areas. Overall, 73% of the girls and 77% of the boys were Tanner stage 4 or 5. Less than 1% of the participants were Tanner stage 1.

Figure 1 shows the mean height-for-age z-scores for boys and girls according to geographic region. Overall, adolescents from the North region had the lowest height-for-age z-scores. By 17 years of age, the mean heights for girls and boys were 160.9 ± 0.1cm and 173.7 ± 0.3cm, respectively. Among the five regions, the mean heights ranged from 158.6cm (North) to 161.6cm (Central-West) for girls, and ranged from 171cm (North) to 174.3cm (Southeast) for boys. Supplementary Material (http://cadernos.ensp.fiocruz.br/static//arquivo/supl-e00277321_3405.pdf) shows the complete data. We also calculated the approximate height difference between the ages of 12 and 17 years according to geographic region. For girls, the smallest difference was in the Northeast (4cm) and the largest was in the Southeast (5.9cm). For boys, the smallest variance was in the North (17.9cm) and the largest in the Southeast (19.5cm).

Figure 2 presents the mean height-for-age z-score by age according to socioeconomic status and school type. At 15 and 17 years of age, the mean height-for-age z-scores were lower for girls in the first socioeconomic tercile. For boys, the lowest income group had a shorter mean height at 12 and 15-17 years of age. Overall, the mean height-for-age z-scores were higher for private school students across all age groups for boys and for most of the girls.

Figure 3 shows mean height-for-age z-scores by age according to BMI classification. Girls with obesity were the tallest at 12-14 years of age, while 13- to 15-year-old girls with underweight had the shortest statures. By 17 years of age, there was no significant difference between girls with obesity and underweight, while girls with overweight had the lowest height-for-age z-scores. Boys with overweight and obesity had the highest height-for-age z-scores at ages 12-16, while boys with underweight had the lowest. Nevertheless, the mean heights were similar across all BMI classifications at 17 years of age.

In the multiple linear regression analysis, underweight (β = 0.205, 95%CI: 0.028; 0.382, p = 0.023), physical activity (β = 0.119, 95%CI: 0.035; 0.202, p = 0.006), and high maternal education (β = 0.103, 95%CI: 0.001; 0.204, p = 0.047) were positively associated with height-for-age z-score in girls aged 16-17 years. However, overweight was inversely associated with height-for-age z-score in girls aged 16-17 years (β = -0.097, 95%CI: -0.191; -0.003, p = 0.043). Maternal education, overweight, and obesity were independently associated with higher height-for-age z-score in girls aged 14-15 years. Overweight and obesity were also positively related to height in girls aged 12-13 years. For boys, higher maternal education (β = 0.39, 95%CI: 0.245; 0.534, p < 0.001), physical activity (β = 0.092, 95%CI: 0.012; 0.172, p = 0.024), higher protein consumption (β = 0.022, 95%CI: 0.010; 0.035, p < 0.001), and obesity (β = 0.217, 95%CI: 0.084; 0.350, p = 0.001) were positively associated with height-for-age z-score at 16-17 years of age. Private school education and maternal education were independently

Table 1

Characteristics of the study participants.

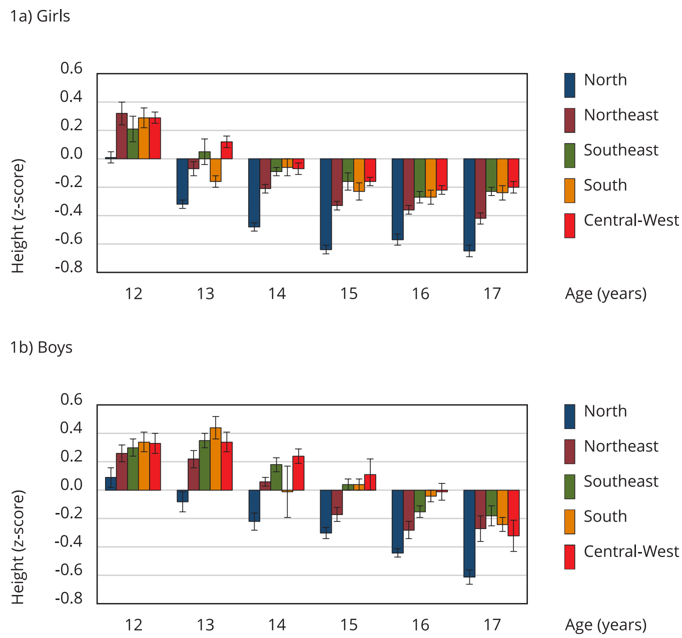
	Brazil (n = 71,553)	
	Girls (55.5%)	**Boys (45.5%)**
	%	**%**
Age (years)		
12	11.2	11.2
13	16.3	16.8
14	18.1	18.3
15	18.7	19.6
16	20.3	19.3
17	15.5	14.8
Ethnicity		
White	39.5	40.5
Black	6.8	9.9
Mixed-race	51.2	46.6
Others	2.6	3.0
Socioeconomic status (terciles)		
First	39.1	31.0
Second	32.9	32.5
Third (richest)	28.0	36.5
Maternal education (years)		
0-3	10.8	9.0
4-8	26.8	26.5
9-12	35.7	32.8
> 12	26.8	31.7
School area		
Urban	96.3	96.0
Rural	3.7	4.0
School type		
Public	83.3	82.0
Private	16.7	18.0
Physical activity		
Inactive	65.0	42.0
Active	35.0	58.0
Diet quality index [mean (SE)]	14.9 (0.1)	19.0 (0.1)
Tanner		
Stage 1	0.5	0.7
Stage 2	4.7	7.2
Stage 3	22.1	14.8
Stage 4	37.0	43.8
Stage 5	35.6	33.5
Age at menarche (years) [mean (SE)]	11.7 (0.1)	NI

NI: not informed; SE: standard error.

associated with higher height-for-age z-score for boys aged 12-15 years. Overweight and obesity were positively associated with height-for-age z-score, whereas underweight was negatively related to height-for-age z-score in boys aged 12-15 years. Table 2 shows the complete multiple linear regression models for all age categories. We found no significant association between height-for-age z-score and DQIA-BR in both sexes. Mean height in the North was lower than in the other four regions.

Figure 1

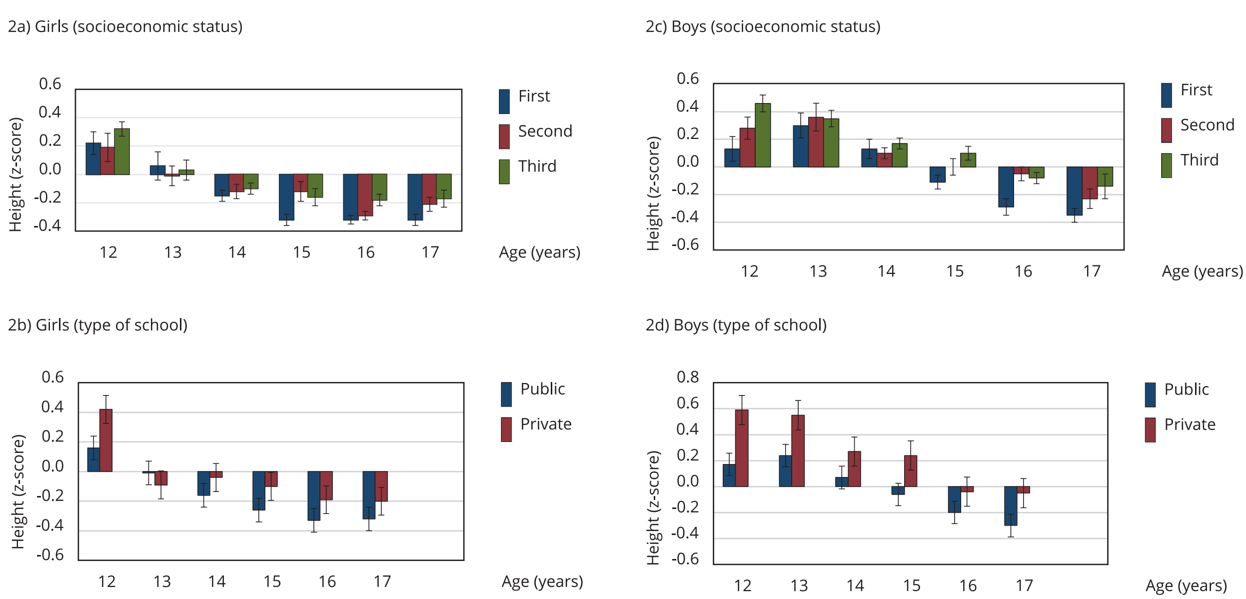
Mean height-for-age z-scores according to geographic region.



Note: z-scores were calculated using World Health Organization (WHO) macros.

Figure 2

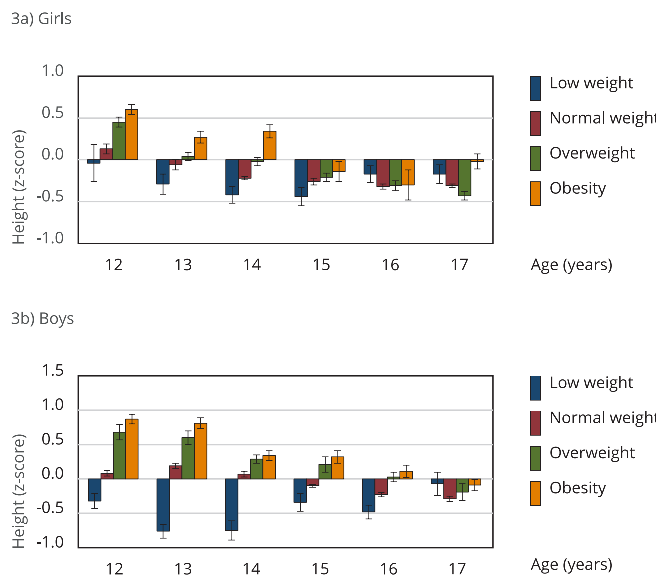
Mean height-for-age z-score by age according to socioeconomic status and type of school.



Note: third tercile = richest. Z-scores were calculated using World Health Organization (WHO) macros.

Figure 3

Mean height-for-age z-score by age according to body mass index (BMI).



Note: z-scores were calculated using World Health Organization (WHO) macros.

Discussion

Our study described height in a representative sample of adolescents from all five Brazilian regions. We found a lower mean height in girls and boys from the North region. We also evaluated the socioeconomic and nutritional factors that may be associated with normal growth and identified a lower mean height in adolescents from public schools, in the lower socioeconomic tercile, and with lower maternal education. We found no association between diet quality index and height. Boys with overweight and obesity were taller until 16 years of age, whereas boys with low weight were shorter until 15 years of age. Finally, girls with obesity had the highest height-for-age z-scores at 12-14 years of age, whereas girls with low weight had the lowest height-for-age z-scores at 13-15 years of age.

This is the largest anthropometric survey yet to oversee Brazilian adolescents. By 17 years of age, the mean heights of girls and boys were 160.9cm and 173.7cm, respectively. Worldwide, the Netherlands has the tallest population (mean adult heights of 183.8cm and 170.7cm for men and women, respectively), followed by Denmark (183.7cm and 168.6cm for men and women, respectively) and Norway (182.0cm and 169.0cm for men and women respectively) [26]. Regarding Latin America, the mean heights for girls and boys aged 18 years were recently reported as 161.1cm and 174.3cm, respectively, in Santa Rosa, Argentina, and 158.1cm and 170.9cm, respectively, in Bogota, Colombia [27,28]. An elegant review about the worldwide variation in childhood and adolescent growth classified populations into four geographically-based regions of ancestral origin (Africa, East Asia, South and West Asia, and Europe); they found that northern European boys and girls were the tallest and Asian boys and girls were the shortest at 17 years of age [10]. Recently, a large study assessed the trends from 1985 to 2019 in mean height for school-aged children and adolescents in 200 countries and territories [11]. The authors estimated a difference of 20cm or higher in mean height of 19-year-old adolescents between countries with the tallest populations (Northwestern and Central European countries) and those with the shortest populations (South and Southeast Asia, Latin America, and East Africa). This height difference represents approximately 8 years of growth gap for girls and approximately 6 years for boys.

Table 2

Multiple linear regression models between exposure variables and height-for-age z-score by sex and age.

Age (years)	Girls			Boys		
	Coefficient	95%CI	p-value	Coefficient	95%CI	p-value
12-13						
BMI *						
Normal weight (reference)						
Underweight	-0.139	-0.377; 0.098	0.250	-0.573	-0.747; -0.399	< 0.001
Overweight	0.117	0.019; 0.216	0.020	0.391	0.194; 0.589	< 0.001
Obesity	0.435	0.291; 0.580	< 0.001	0.712	0.564; 0.859	< 0.001
Protein consumption *,**	0.016	-0.002; 0.034	0.091	0.015	-0.001; 0.032	0.067
Physical activity (> 60 min/day) *	-0.015	-0.109; 0.080	0.762	-0.040	-0.144; 0.064	0.454
Black/Mixed-race ***	-0.034	-0.140; 0.072	0.524	0.048	-0.080; 0.176	0.463
Private school #	-0.025	-0.144; 0.093	0.675	0.326	0.213; 0.439	< 0.001
Maternal education (years) ##						
< 4 (reference)						
4-8	-0.026	-0.201; 0.149	0.774	0.147	-0.076; 0.370	0.197
9-12	0.021	-0.169; 0.210	0.830	0.231	0.021; 0.442	0.031
> 12	0.097	-0.105; 0.299	0.348	0.259	0.032; 0.485	0.025
14-15						
BMI *						
Normal weight (reference)						
Underweight	-0.032	-0.170; 0.105	0.643	-0.466	-0.643; -0.289	< 0.001
Overweight	0.096	0.017; 0.176	0.018	0.292	0.147; 0.438	< 0.001
Obesity	0.353	0.171; 0.535	< 0.001	0.398	0.279; 0.517	< 0.001
Protein consumption *,**	0.002	-0.011; 0.016	0.735	0.011	-0.007; 0.028	0.228
Physical activity (> 60 min/day) *	0.035	-0.022; 0.093	0.223	-0.034	-0.140; 0.072	0.527
Black/Mixed-race ***	-0.064	-0.163; 0.035	0.203	-0.001	-0.080; 0.078	0.975
Private school #	0.071	-0.036; 0.178	0.191	0.125	0.019; 0.231	0.020
Maternal education (years) ##						
< 4 (reference)						
4-8	0.072	-0.105; 0.249	0.427	0.133	-0.003; 0.269	0.055
9-12	0.135	0.021; 0.249	0.020	0.161	0.024; 0.298	0.022
> 12	0.158	0.025; 0.291	0.020	0.217	0.049; 0.384	0.011
16-17						
BMI *						
Normal weight (reference)						
Underweight	0.205	0.028; 0.382	0.023	-0.075	-0.299; 0.149	0.511
Overweight	-0.097	-0.191; -0.003	0.043	0.066	-0.072; 0.205	0.349
Obesity	0.064	-0.199; 0.326	0.634	0.217	0.084; 0.350	0.001
Protein consumption *,**	0.001	-0.015; 0.015	0.993	0.022	0.010; 0.035	< 0.001
Physical activity (> 60 min/day) *	0.119	0.035; 0.202	0.006	0.092	0.012; 0.172	0.024
Black/Mixed-race ***	0.073	-0.001; 0.148	0.053	0.009	-0.097; 0.115	0.870
Private school #	0.081	-0.007; 0.168	0.073	0.096	-0.023; 0.214	0.114
Maternal education (years) ##						
< 4 (reference)						
4-8	0.082	-0.042; 0.205	0.195	0.249	0.114; 0.384	< 0.001
9-12	0.103	0.001; 0.204	0.047	0.312	0.183; 0.440	< 0.001
> 12	0.072	-0.063; 0.206	0.294	0.390	0.245; 0.534	< 0.001

95%CI: 95% confidence interval; BMI: body mass index.

* Adjusted for region, skin color, maternal education, type of school, Tanner stage;

** Higher protein consumption;

*** Adjusted for region, maternal education, type of school, Tanner stage;

Adjusted for region, maternal education, skin color, Tanner stage;

Adjusted for region, skin color, type of school, Tanner stage.

In our study, we found a positive association between height and physical activity, which may be due to confounding factors. The influence of physical activity on the final height in this age group has no scientific basis, therefore, adolescents who undergo faster maturation or favorable biotype, becoming taller and stronger earlier, tend to have a sporting advantage during childhood, especially in team sports widely practiced in Brazil, and this becomes an incentive to be active. Although there is no causality, the practice of physical activity at this age is important for bone and muscle formation [29].

In Brazil, there are still significant inequalities regarding living conditions, access to healthcare and general sanitation services, in addition to the considerable regional economic differences: the Northeast and North have the lowest per capita income, and the Southeast and South the highest [30]. Overall, the lowest height in both sexes was found in the North. The socioeconomic factors associated with lower height were: attending a public school, belonging to the lowest socioeconomic tercile, and lower maternal education, which may reflect the effect of better living conditions on healthy growth. A previous study with 3,470 boys born in the municipality of Ribeirão Preto (São Paulo State, Brazil) found that social class at birth and neighborhood income were highly associated with height at 18 years of age; contrasting with our study, in which we found that maternal education was not associated with height at 18 years of age [12].

Hormonal factors may be involved in the association between accelerated growth and high BMI [31,32,33]. Children with higher BMI during infancy and childhood were shown to have faster subsequent growth in stature and earlier pubertal development, with slower linear growth during adolescence [34]. Moreover, chronically overweight and obese children presented the highest risk of early pubertal maturation. In contrast, rapid BMI growth was associated with an increased risk of early puberty in girls but not in boys [35]. In our study, adolescent boys with overweight and obesity were taller until 16 years of age, while the underweight subgroup had a lower mean height from 12-15 years of age in multiple linear regression models adjusted for Tanner stage, region, and socioeconomic factors. Surprisingly, underweight was positively associated with height in girls aged 16-17 years. A previous report on the ERICA study found that the median age at menarche was lower in girls with overweight and obesity [36]. The median age of menarche was 13.5 years in girls with severe underweight; 13.4 years in girls with underweight; 12.5 years in girls with normal weight; 12.0 years in girls with overweight; and 11.9 years in girls with obesity. In our study, the difference in height between adolescents aged 12 and 17 years was much smaller in girls (around 5cm) than boys (around 18cm), since most girls are in the post-menarche period when growth velocity decreases [37].

We found no association between height and diet quality. The impact of diet on final height cannot be ignored, since it provides essential energy substrates for growth regulation, bone mass formation, and nutritional status, thus influencing the growth pattern [38]. We believe that the way food intake was assessed in our study contributed to the lack of an association with height.

Our study has some limitations. First, since ERICA was a cross-sectional study, there was no longitudinal monitoring of growth, and we could not establish a causal relationship between the evaluated factors and height. Second, more than 70% of the adolescents were Tanner stage 4 or 5, with Tanner stage 1 reported in less than 1% of the participants. Third, Tanner stage was based on the adolescents' self-assessment, despite recent meta-analysis reporting good agreement between self-assessed and clinician-assessed Tanner stages [39]. Fourth, the DQIA-BR does not quantify the mean micronutrient intake in isolation, and there is a risk of underreporting consumption. To reduce bias, a second 24-hour recall was applied to a subsample [40,41]. Nonetheless, our study is a large, multiethnic, population-based representative assessment of anthropometric data from adolescents in a middle-income country. The anthropometric evaluation was standardized and followed a specific protocol, with height measured to the nearest 1mm and repeated for quality control purposes.

In conclusion, the current study described the height of a large representative sample of Brazilian adolescents, detecting expected differences in mean stature among the five regions, which may reflect the discrepancies of a large country with economic and social inequalities. These associations are related to better living conditions that certainly influence healthy growth. Our findings highlight the environmental influence on anthropometric parameters and the importance of promoting educational, nutritional, and economic actions to reach the maximum growth potential in youth.

Contributors

A. V. Cheuiche participated on the planning, interpretation and writing of the article. F. V. Cureau collaborated on the planning, data analysis and revision of the article. M. M. Madalosso contributed on the data interpretation and writing of the article. G. H. Telo participated on the planning, writing review of the article. B. D. Schaan contributed on the design of the study, writing and review of the article.

Additional informations

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Resumo

Buscou-se descrever a altura média dos adolescentes das cinco regiões do Brasil e avaliar os fatores socioeconômicos e nutricionais que estejam associados ao seu crescimento normal. Este é um estudo transversal realizado em ambientes urbanos e rurais no Brasil com estudantes de 12 a 17 anos (n = 71.553). Avaliamos antropometria, variáveis socioeconômicas, atividade física e dieta. Calculou-se os escores-z por idade e investigou-se a associação das variáveis de exposição com altura (desfecho) por sexo e idade (12-13, 14-15 e 16-17 anos) através de múltiplos modelos de regressão linear. Observou-se menor altura média em adolescentes da região Norte e em baixos níveis socioeconômicos. Aos 17 anos, o mais próximo da altura final nesta amostra, as alturas médias para meninas e meninos foram de 160,9 ± 0,1cm e 173,7 ± 0,3cm, respectivamente. Na análise de regressão linear múltipla, atividade física (meninas β = 0,119, IC95%: 0,035; 0,202; meninos β = 0,092, IC95%: 0,012; 0,172) e Ensino Médio materno (meninas β = 0,103, IC95%: 0,201; 0,204; meninos β = 0,39, IC95%: 0,245; 0,534) estiveram positivamente associados ao escore-z de altura por idade em meninos e meninas de 16-17 anos. Maior consumo de proteína (β = 0,022, IC95%: 0,010; 0,035) e obesidade (β = 0,217, IC95%: 0,084; 0,350) estiveram positivamente associados ao escore-z de altura para a idade meninos mais velhos, enquanto a variável associada às meninas foi baixo peso (β = 0,205, IC95%: 0,028; 0,382). Observou-se diferenças na altura média de adolescentes das cinco regiões brasileiras. O crescimento normal, especialmente entre adolescentes mais velhos, esteve associado à escolaridade materna, à prática de atividade física, ao consumo de proteínas e às categorias de índice de massa corporal (IMC).

Estatura; Antropometria; Adolescente; Fatores Socioeconômicos

Resumen

Los objetivos fueron describir la estatura media de los adolescentes de las cinco regiones de Brasil y evaluar los factores socioeconómicos y nutricionales asociados al crecimiento normal. Estudio transversal realizado en entornos urbanos y rurales de Brasil con estudiantes de 12 a 17 años (n = 71.553). Se evaluaron la antropometría, las variables socioeconómicas, la actividad física y la dieta. Se calculó la puntuación Z de la altura para la edad y se utilizaron modelos de regresión lineal múltiple para investigar la asociación de las variables de exposición con la altura (resultado) por sexo y edad (12-13, 14-15 y 16-17 años). Se observó una estatura media más baja en los adolescentes de la región norte y en los de nivel socioeconómico bajo. A los 17 años, la edad más cercana a la estatura final en esta muestra, las estaturas medias de las chicas y los chicos eran de 160,9 ± 0,1cm y 173,7 ± 0,3cm, respectivamente. En el análisis de regresión lineal múltiple, la actividad física (chicas β = 0,119, IC95%: 0,035; 0,202; chicos β = 0,092, IC95%: 0,012; 0,172) y la madre con educación secundaria (chicas β = 0,103, IC95%: 0,001; 0,204; chicos β = 0,39, IC95%: 0,245; 0,534) se asociaron positivamente con la puntuación z de la altura para la edad en chicos y chicas de 16-17 años. En el caso de los chicos, el mayor consumo de proteínas (β = 0,022, IC95%: 0,010; 0,035) y la obesidad (β = 0,217, IC95%: 0,084; 0,350), mientras que, en el caso de las chicas, el bajo peso (β = 0,205, IC95%: 0,028; 0,382) también se asociaron positivamente con la puntuación z de la altura para la edad en los estudiantes mayores. Se observaron diferencias en la estatura media entre los adolescentes de las cinco regiones brasileñas. El crecimiento normal, especialmente entre los adolescentes de mayor edad, se asoció con la alta escolaridad de la madre, la práctica de actividad física, el consumo de proteínas y las categorías de índice de masa corporal (IMC).

Estatura; Antropometría; Adolescente; Factores Socioeconómicos

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